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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION SPECIFICATION

SYSTEM MAINTENANCE MONITOR CONSOLE

1.0 SCOPE

1.1 Scope - This specification sets forth the requirements for a System Maintenance Monitor Console (SMMC) to be used as part of the National Airspace System (NAS) En Route. The System Maintenance Monitor Console (SMMC) will be located in the operating area of an Air Route Traffic Control Center (ARTCC). It will be manned by a System Engineer (SE) and an Assistant Systems Engineer (ASE) and will monitor and display the status, configuration and performance of the NAS ARTCC equipment system. The SMMC will automatically input changes in status, configuration and performance to the Central Computer Complex (CCC). On command, a summary of all status, configuration and performance data stored in the SMMC will be input to the CCC. An I/O typewriter, installed in the SMMC will provide for input and output of data to and from the CCC.

This specification covers the design, fabrication, test and delivery of the SMMC equipment and the requirements for supporting documentation.

2. Applicable Specifications, Standards and Other Publications

2.1 FAA documents - The following FAA specifications, standards and drawings, of the issues specified in the IFB or RFP, form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA specifications -

FAA-G-2100/1 Electronic Equipment, General Requirements; Part 1, General Requirements for All Equipment

FAA-G-2100/2 Part 2, Requirements for Equipment Employing Electron Tubes

FAA-G-2100/3 Part 3, Requirements for Equipment Employing Semiconductor Devices

FAA-G-2100/4 Part 4, Requirements for Equipment Employing Printed Wiring Techniques

FAA-E-163 Rack, Cabinet and Open Frame Types

FAA-D-638 Instruction Books, Electronic Equipment

FAA-D-2129 Contractor Prepared Technical Reports

FAA-E-2235 FAA and DOD Joint Specification Transmitting Set, Coordinate Data AN/FYQ-47, 48, and 49

2.1.2 FAA Standards -

FAA-STD-002 Engineering Drawings

FAA-STD-007 Pert Procedures for Contract Use

FAA-STD-012 Paint Systems for Equipment

2.2 Military publications - The following Military publications, of the issues in effect on the date of the IFB or RFP, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military Standard -

MIL-STD-461 Electromagnetic Interference Characteristics - Requirements for Equipment

MIL-STD-462 Electromagnetic Interference Characteristics, Measurement of

MIL-STD-463	Military Standard - Definition and Systems of Units, Electromagnetic Interference Technology
MIL-STD-470	Military Standard - Maintainability Program Requirements (For Systems and Equipment)
MIL-STD-471	Military Standard - Maintainability Demonstration
MIL-STD-785	Military Standard - Requirements for Reliability Program (For Systems and Equipment)
MIL-STD-721B	Military Standard - Definition of Effectiveness Terms for Reliability Maintainability, Human Factors and Safety.
MIL-HDBK-217	Reliability Stress and Failure Rate Data for Electronic Equipment

2.2.2 Military specification.-

MIL-E-17555	Packing of Electronic Equipment
MIL-I-45208A	Inspection System Requirements

2.3 Copies of publications.- Copies of this specification and other applicable FAA specifications and standards may be obtained from the Federal Aviation Administration, Washington, D. C., 20590, Attention: Contracting Officer, NASPO. The request should identify the material desired; i.e., specification numbers, issue dates, amendment numbers, complete drawing numbers; also the request should state the IFB, RFP, contract number or other use to be made of the requested material. Information on obtaining single copies of Military specifications is contained in Supplement-1 FAA-G-2100/1.

3. REQUIREMENTS

3.1 General requirements.- The SMMC shall provide a centralized monitoring and control position for the System Engineer of a NAS ARTCC system. The SMMC shall provide a continual display of status for all major equipment in the system. Where applicable, it shall display configuration of the equipment elements in the major subsystems and, to the extent information is available, it shall indicate a level or degree of performance. The SMMC shall include two CRT displays one of which will select and display inputs from any one, of up to 18, of the radars remoted to the ARTCC and one of which will select and display any one, of up to 60, of the display channel outputs of the Computer Display Channel (CDC).

The SMMC shall be primarily a passive monitoring device which will receive data, on a non-interference basis, from the equipment being monitored. It shall input data to the CCC through a General Purpose Input (GPI) adapter for the purpose of storage and printout. The SMMC shall automatically send any changes of monitored data to the CCC and perform a summary read-in of all data, when commanded by the System Engineer or when activated by the CCC program.

The SMMC shall provide mounting facilities for an IBM-1052-07 printer Keyboard with its associated signal and power cables. It shall also provide for paper storage, paper feed to the typewriter and space for the stacked printouts from the typewriter.

The SMMC shall provide for installation of two telephone communication positions at the console, for installation of the UPS Status Panel and mounting facilities for a GFE Wickes clock.

The SMMC shall provide a full length writing shelf with two pullout, convenience drawers and two built in removable ash trays. The central portion of the rack space over the I/O typewriter shall be enclosed to provide storage and shelf space similar to that shown by Figure 1.

The SMMC shall be modular in construction to allow rearrangement and expansion of monitoring capability. It shall provide visual and aural attention signals whenever there is a change in the automatic input monitoring signals.

3.1.1 Equipment to be furnished by the contractor.- Each SMMC furnished by the contractor shall be complete in accordance with all specification requirements and shall include the items listed below. Any feature or item necessary for proper operation in accordance with the requirements of this specification, shall be incorporated even though that feature or item may not be specifically described herein. The contractor shall provide the following items in accordance with the indicated paragraphs of this specification in the quantities required by the contract:

(a)	Systems Maintenance Monitor Console	3.5
(b)	SMMC Equipment Room Equipment	3.5
(c)	SMMC Monitoring Modules	3.3
(d)	Cables	3.7
(e)	Documentation	3.10

3.1.2 Prototype equipment.- The contractor shall fabricate a prototype SMMC for purposes of preliminary testing and inspection, for verification of layout and form factor and for use by the contractor in production engineering. The prototype shall be complete in all features, functions and provisions and shall contain at least one of each type of module. When no longer required by either the FAA or contractor and at least three months

prior to delivery of the last SMMC equipment, the prototype shall be reworked to a like-new condition, augmented with additional equipment, as necessary, and delivered as the final equipment unit. The FAA factory representative will inspect and approve those parts of the prototype which may be reclaimed for delivery.

3.1.3 Equipment to be furnished by the Government.- The following equipment will be furnished by the Government:

*(a) Wickes clock - 1 per SMMC
(b) I/O typewriter, IBM model 1052-07 - 1 per SMMC
(c) Telephone equipment for two positions in each SMMC
*(d) CDC display and control panel - 1 per SMMC
*(e) CDC Instruction books - 1 set
(f) Interconnection cables for CDC display and control panel - 1 set per SMMC
(g) UPS Operational Status Panel - 1 per SMMC

*NOTE: Items a, d, and e will be delivered to the contractor. Items b, c, f, and g will be GFE after delivery of the SMMC equipment.

3.2 Definitions

3.2.1 NAS ARTCC equipment system.- The term "NAS ARTCC Equipment System" as used herein refers to the technical equipment system encompassed within an ARTCC area and used for air traffic control. Included in this equipment system are such major equipment subsystems as the Data Acquisition and Transfer Group (radar, beacon, digitizer and modems), the Central Computer Complex, the Computer Display Channel, Communications equipment (air/ground radio, telephone, teletype, and data channels), Navigational Aids, and the ARTCC building environmental equipment (power, air conditioning, and radiation monitor).

3.2.2 Major equipment subsystems.- The principal division of the NAS ARTCC Equipment System is into major equipment subsystems; such as, the Central Computer Complex (CCC) and the Computer Display Channel (CDC).

3.2.3 Elements.- The subdivision of subsystem equipment into separate, identifiable equipment or groups of equipment, functionally identifiable.

3.2.4 System Engineer.--The person, or persons, who perform the monitoring, configuration control, coordination and other Systems Maintenance duties at the SMMC.

3.2.5 Mean-up time (MUT).- Mean-up time is defined as the mean time to failure of the units, or set of units considered, given that the unit or set of units was "up" at time zero.

3.2.6 Mean-down time (MDT).- Mean-down time is defined as the mean time to perform the minimum repair required of the unit, or set of units considered sufficient to return the function performed by that unit, or set of units, to "up", given that the function was down at time zero.

3.2.7 Quick replacement.- The term "quick replacement" as used in this specification with respect to the replacing of parts for maintenance purposes is defined as being a replacement, in five minutes or less, of a defective part when the replacement part is available at the point of replacement.

3.2.8 NAS en route.- This term as used herein applies to a semi-automated air traffic control system for use in the control of air traffic operating within the volume of airspace controlled by an Air Route Traffic Control Center.

3.2.9 Abbreviations

ARTCC	-	Air Route Traffic Control Center
ATC	-	Air Traffic Control
BM	-	Buffer Memory
CCC	-	Central Computer Complex
CCCM	-	CCC Module
CD	-	Common Digitizer
CDC	-	Computer Display Channel
CDC-DM	-	CDC Display Module
CDCM	-	CDC Module
CDM	-	Controller's Display Module
CE	-	Compute Element (CCC)
CFU	-	Control and Format Unit (CDC)
COR	-	Contracting Officer's Representative
CRT	-	Cathode Ray Tube
CTS	-	Coded Time Source
CVG	-	Character Vector Generator (CDC)
DG	-	Display Generator (CDC)
DSG	-	Duplex Switching Group
DRG	-	Data Receiver Group (CD)
ECM	-	Environmental and Control Module
FAA	-	Federal Aviation Administration
GFE	-	Government Furnished Equipment
GPI	-	General Purpose Input (CCC)
HSF	-	High Speed Filter (CDC)
IEE	-	Industrial Electronic Engineering Co.
IFB	-	Invitation for Bids
I/O	-	Input/Output
IOC	-	Input/Output Control (CDC)
IOCE	-	Input/Output Control Element (CCC)
MDT	-	Mean Down Time
MUT	-	Mean Up Time
NACM	-	Nav. Aids and Comm. Module
NAS	-	National Airspace System
NRKM	-	NON Radar Keyboard Multiplexer (CDC)
PAM	-	Peripheral Adapter Module (CCC)
PRI	-	Projection Readout Indicator
RAPPI	-	Random Access Plan Position Indicator
RDM	-	RAPPI Display Module
RFM	-	Remote Facility Module

RFP	-	Request for Proposals
RKM	-	Radar Keyboard Multiplexer (CDC)
RM	-	Refresh Memory (CDC)
RMC	-	Refresh Memory Control (CDC)
RMIOC	-	Refresh Memory Input/Output Control (CDC)
RU	-	Reconfiguration Unit (CDC)
SE	-	Storage Element (CCC)
SMMC	-	System Maintenance Monitor Console
TCU	-	Tape Control Unit (CCC)
UPS	-	Uninterruptible Power Supply

3.3 Modularity.- The SMMC shall be designed and fabricated to be modular in construction and assembly. The monitoring functions shall be modular by equipment type or groups of equipment types; i.e., a Remote Facility Module, a CDC Module, etc. Each module shall by physically and electrically separable from other SMMC modules and equipment. The modular construction shall allow for rearrangement of monitoring capabilities to meet the needs of different locations.

The types of modules defined in the following referenced paragraphs of this specification shall be provided:

(a)	Remote Facilities module	3.5.1
(b)	Central Computer Complex module	3.5.2
(c)	Computer Display Channel module	3.5.3
(d)	Controller's Display module	3.5.4
(e)	Nav. Aids and Comm. module	3.5.5
(f)	Environmental and Control module	3.5.6
(g)	RAPPI Display module	3.5.7
(h)	CDC Display module	3.5.8
(i)	Scanner module	3.5.9

Each monitoring module shall be electrically independent of other equipment except for the following:

(a) Input signals from the monitored equipment.
(b) The interface with the scanner in the SMMC.
(c) Power input from common power supplies in the SMMC.

As necessary, the ECM (f above) may be excepted from this requirement.

Except as otherwise required herein, modular units located in the SMMC console shall be designed to the standard "c" panel size (1-3.4.4, FAA-G-2100/1) for a standard 19 inch equipment cabinet.

3.3.1 Expansion capability.- The equipment design shall be such that the monitoring capability can be expanded by the addition of modules, cabinets, racks, etc., to provide the following maximum capability:

(a)	Radars - dual channel		18
(b)	Beacons - dual channel		18
(c)	Common Digitizers - dual channel*		18
	DRGs (3 channel)		18
(d)	Modems - radar, (3 channel)		18
(e)	CCC		1
	CE element	4	
	SE element	12	
	PAM element	3	
	IOCE element	3	
	TCU element	3	
(f)	CDC		1
	IOC element	2	
	BM element	16	
	RMIOC element	2	
	RMC element	2	
	RKM element	3	
	RM element	9	
	DG element	12	
	RU element	1	
	HSF element	2	
	CFU element	2	
	NRKM element	4	
(g)	Controller displays		70
(h)	Nav. Aids		149
(i)	Comm. Frequencies		248
(j)	Modems (Interfacility - dual channel)		7

*NOTE: The CD equipment is being installed as single channel with the capability to add another unit for duplex operation. The SMMC maximum capability must provide for monitoring CD duplex installations.

3.4 Interface requirements.- The SMMC shall interface with elements and units of the NAS to monitor and display status, configuration and performance. The technical details of these interfaces, electrical and mechanical are described in Section 3.12 of this specification. The SMMC equipment shall be designed to connect to, and operate from, equipment with the interfaces as defined and with up to 300 feet of interconnecting cable.

3.4.1 Non-interference.- The SMMC shall be designed to interface with the equipment being monitored on a non-interference basis. Performance of the equipment being monitored shall not be degraded by the SMMC under any condition.

3.4.2 Conducted and radiated interference.- The SMMC shall be designed to prevent conducted or radiated interference (noise, ground currents, cross talk) from being introduced into the monitored equipment from the SMMC interface. The SMMC equipment shall comply with the conducted and radiated interference requirements of MIL-STD-461, MIL-STD-462 and MIL-STD-463 with all equipment installed and operating in a normal manner.

3.5 Equipment configuration.- The SMMC equipment shall be composed of an SMMC operating console and equipment room cabinets.

The operating console shall be made up of standard 19 inch equipment cabinets containing the monitoring modules and display panels, the CRT displays and a special section (standard 24 inch equipment cabinet size) for the I/O typewriter and storage. (See Figure 1) An overhead turret on each cabinet shall provide a forward tilt of approximately 20^{o} from the perpendicular to provide better viewing of the indicators in the upper portion of the console.

A full length writing shelf containing two convenience drawers, removable ash trays and mounting provisions for telephone communications equipment shall be provided for the console. The space above the I/O typewriter shall be utilized to provide a storage cabinet and shelf as shown in Figure 1. Location of the monitoring modules in the console shall be completely flexible except that none will be located below the writing shelf.

The equipment room cabinets shall consist of standard 19 inch equipment cabinets containing the back room equipment for the monitoring modules.

The SMMC design shall allow for satisfactory operation with up to 300 feet of cable between the SMMC and its equipment room cabinets.

3.5.1 Remote facility module (RFM).- The Remote Facility Module (RFM) in the SMMC shall monitor and display status and performance of the equipment associated with the remote radar facilities, utilizing projection readout indicators (PRI's) mounted on a standard size "C" panel. Each module shall display monitoring data for two radar facilities. The RFM shall monitor the following equipment for each facility:

(a) Radar - 1 (dual channel)
(b) Beacon - 1 (dual channel)
(c) CD - 1 (single channel)*
(d) Modem - 1 (three channel)
(e) DRG - 1 (three channel)

*NOTE: All necessary wiring circuitry, components and panel space, shall be provided in the SMMC for monitoring the CD, dual channel. The second PRI shall not be provided and the panel cutout shall be closed by a cover or insert.

Interface, buffering and logic circuitry may be located in the equipment room cabinets, as necessary.

3.5.1.1 Interface requirements.- The RFM shall interface with a Data Receiver Group (DRG) of the Common Digitizer (CD), and from the data received, display status and performance. The RFM shall receive status

messages from the remote CD, decode the messages and display pertinent status and performance data applicable to the remote radar, beacon, CD and modem equipment. Technical details of this interface and status message content are defined in section 3.12.1.

The RFM shall receive input signals direct from the receiving modems for the display of modem alarms and line status; as defined in section 3.12.3.

The RFM shall receive input signals direct from the DRG for the display of DRG alarms and other signals, as defined in section 3.12.1.3.

3.5.2. Central Computer Complex Module (CCCM).- The CCCM shall interface with the System Console of the CCC to monitor and display status, configuration, and performance in accordance with the signals received from the CCC.

3.5.2.1 CCCM interface requirements.- The interface with the System Console is described in section 3.12.2.

3.5.2.2 CCCM configuration.- The CCCM monitoring module in the SMMC console shall provide for monitoring the following CCC elements:

(a)	Compute element (CE)	- 4
(b)	Storage element (SE)	- 12
(c)	I/O Control element (IOCE)	- 3
(d)	Peripheral Adapter Module (PAM)	- 3
(e)	Tape control unit (TCU)	- 3

Interface, buffering, and logic circuitry may be located in the equipment room cabinets, as necessary.

3.5.3 Computer display channel module (CDCM).- The CDCM shall interface with the CDC equipment to monitor and display status, configuration, and performance of the CDC equipment.

3.5.3.1 Interface requirements.- The CDCM shall interface with the CDC at the Reconfiguration Unit (RU) and at the Non Radar Keyboard Module (NRKM). Technical details of these interface are given in section 3.12.4

3.5.3.2 CDCM configuration.- The configuration of PRI's on the monitor panels shall be determined by the contractor, subject to approval by the FAA. Interface, buffering and logic circuitry for the CDCM may be located in the equipment room cabinets, as necessary.

The CDC module shall provide for monitoring the following CDC elements:

(a)	Input/Output Control (IOC)	2
(b)	Buffer Memory (BM)	16
(c)	Refresh Memory I/O Control (RMIOC)	2
(d)	Refresh Memory Control (RMC)	2
(e)	Radar Keyboard Multiplexer (RKM)	3
(f)	Refresh Memory (RM)	9
(g)	Display Generator (DG)	12
(h)	Reconfiguration Unit (RU)	1

(i)	High Speed Filter (HSF)	2
(j)	Control and Format Unit (CFU)	2
(k)	Non Radar Keyboard Multiplexer (NRKM)	4

3.5.4 Controller's display module.- The CDM shall display status and failure information from the controller's display position. The information to be displayed shall be in accordance with signals received from the CDC.

3.5.4.1 Interface requirement.- The CDM shall receive status information on the controller's display from the CDC through the CDCM interface.

3.5.4.2 Configuration.- Each CDM shall provide monitoring for 24 controller's display positions. The indicators shall be mounted on a standard size "C" panel with a maximum of three CDM's per SMMC.

3.5.5 Navigation Aids and Communications module (NACM).- The NACM shall display status of the Navigative Aid facilities and the Air/Ground Communication frequencies. The NACM shall interface with the SMMC scanner equipment for the input of status data to the CCC.

3.5.5.1 Status Indication.- A status indicator shall be provided for each Navigation Aid Facility and for the transmit function and for the receive function for each communication frequency. The indicator shall be set by a push button switch which shall cause the alternate lighting of red and green indicators.

Activation of the switch shall initiate a change to the scanner for input to the CCC. The switches shall be self locking, such that after a power interruption, the status indications in this module shall be unchanged.

3.5.5.2 Module size.- The NACM shall utilize a standard size "C" panel and shall be designed to provide a maximum capability of 72 indicator/switches per module. The SMMC design shall provide a maximum capability of six NACM's per SMMC.

3.5.6 RAPPI display module (RDM).- The RAPPI display module shall operate from the output signals of any one, of up to 18, DRG equipments. The display module shall provide a selection and switching capability to select the output signals of any DRG for display at the RDM and to select any one, or all, of the three channels of the DRG, for display. The RAPPI display shall utilize a 16 inch, round cathode ray tube with aluminumized P-38 phosphor and bonded safety faceplace. The display shall meet the general display requirements specified in Section 3.5.10.2.

The display module shall contain all necessary logic, switching, and display circuitry to accept DRG output signals, convert to display voltages and display the selected data on the CRT at the required brightness, contrast and resolution.

3.5.6.1 Operator controls.- The following display controls shall be provided:

Power on/off
Brightness (symbol gain)
Focus
Horizontal position
Vertical position
Symbol size

The following selection controls shall be available at the RAPPI Display module:

DRG selection
Channel selection
Range selection
Symbol selection

3.5.6.2 Symbol selection and generation.- The RAPPI Display Module shall be capable of generating up to 18 different symbols for display on the CRT. The symbol configurations shall be as listed below:

	Symbol	Meaning
1.		Spare
2.		BOMARC
3.		Emergency
4.		Search reinforced
5.		Mode 3A
6.		Mode 2
7.		Mode C
8.		Any beacon
9.		Search only
10.		Gap filler
11.		Strobe
12.		Map normal
13.		Map sensitive
14.		Map fixed

	Symbol	Meaning
15.		Height finder
16.	•	Any message with symbol select off
17.	|	Inner contour-weather
18.	—	Outer contour-weather

3.5.6.2.1 Sybmol selection.- Any symbol, any combination of symbols, and all symbols shall be selectable by the operator for display at the RDM.

3.5.6.2.2 Symbol size.- Nominal symbol size shall be 1/4" X 1/4" for the □ symbol. Symbol size shall be adjustable ± 20% except for the dot which shall be approximately 1/16" in diameter.

3.5.6.3 Symbol generator.- The symbol generator shall be programable, within the limits of the symbol segments and shapes provided by the symbol generator to provide for changing symbols, on an individual basis, by replacing plug-in modules or cards in the symbol generator.

3.5.6.4 Beam positioning and symbol writing rate.- Starting at any point on the display, the RAPPI Display Module shall be capable of repositioning the CRT electron beam one display diameter (useable), settling to a quiescent condition, (current and voltage) and tracing a symbol without noticeable blurring, in 500 microseconds, or less.

3.5.6.5 Test target offset.- Two test target symbols (for radar and beacon test targets) shall be offset automatically to positions at the display circumference, regardless of the selected range scale. Positioning of the test target symbols with respect to the display circumference shall be adjustable ± 5% of the display diameter, by a maintenance adjustment. A switch shall be provided to disable the test target offset, in which case all test targets shall be displayed at the correct range and azimuth as contained in the test target message.

3.5.6.6 Display mounting.- The RAPPI Display unit shall be designed for mounting in a standard 19 inch equipment cabinet in the SMMC console. The display shall be mounted on rails so that it can be pulled out for maintenance at the console or removed for repair. Maintenance adjustments and test points shall be readily available with the unit pulled out and operating.

3.5.7 CDC display module (CDC-DM).- The CDC display module will provide for the selection and display at the SMMC of the data being displayed at any of the ATC operator displays. The CDC-DM will consist of a CDC display (less CRT) and Keyboard, which will be GFE to the contractor's plant. (Cables to connect the display to the CDC will be GFE at the site.)

3.5.7.1 Interface requirements.- The CDC-DM will interface with the CDC at a DG (Display Generator) and at a RKM (Radar Keyboard Multiplexer).

3.5.7.2 Physical integration.- The contractor shall incorporate the CDC display and keyboard into the SMMC console to provide an integrated display capability. The CDC display equipment shall be repackaged, as necessary, to mount in the SMMC cabinet as a verticle display. The display shall be installed on pull out slides for ease of inspection, adjustment and maintenance.

The keyboard shall be installed in the console at the best, available location for operator usage. The Keyboard shall be easily removeable for maintenance.

3.5.7.3 Display modification.- The contractor shall provide and install a 16 inch CRT in the CDC display in place of the 22 inch CRT originally used. The 16 inch CRT shall be similiar and equal to Rauland tube, type R-6326-L. The 16 inch CRT shall utilize the same pin connections and the same voltages as the 22 inch CRT and shall require no change to the CDC display equipment to operate, other than adjustment. The 16 inch CRT shall have a bonded safety faceplace, with a clear conductive coating for electrostatic shielding. The faceplace shall have an orientation mark (or marks) for positioning the tube for correct presentation of alpha-numerics. The useable display diameter shall be 14 inches or greater.

The contractor shall modify the GFE CDC display equipment, as necessary, to operate with the 16 inch CRT and to mount in the SMMC cabinet.

The CDC display, with the 16 inch CRT installed and mounted in the SMMC cabinet, shall meet the same performance criteria as a 22 inch CDC display except for the possible change in resolution directly related to the change of display diameter.

3.5.7.4 Documentation.- The contractor shall incorporate information from the Government furnished CDC instruction book material into the SMMC instruction books, suitably revised to reflect any changes and to describe operation and maintenance of the CDC-DM in the SMMC.

3.5.8 Environmental and control module (ECM).- The Environmental and Control Module shall incorporate various miscellaneous monitoring and control functions and provide panel space for the overflow of certain monitoring and control functions associated with the CCC.

The following monitoring and control shall be provided by the ECM:

(a) Environmental

(1) Air conditioning
(2) Radiation alarm
(3) Door alarm
(4) Fire alarm

(b) Central Computer Complex

(1) CCC Mode
(2) GPI (status and control)

(c) Interfacility Modems

(1) Up to six on-line transmitter and receiver modem groups
(2) One spare transmitter and receiver modem group

(d) Miscellaneous

(1) Coded Time Source
(2) SMMC Equipment Room Cabinets (power and status)
(3) SMMC (indicators and controls)
(4) PRI Test

3.5.8.1 Interface requirements

3.5.8.1.1 Environmental.- The input signals to the ECM will be as follows:

(a) Air Conditioning
Relay contacts dry - normally closed, open indicates alarm.

(b) Radiation
Relay contacts, dry - normally closed, open indicates alarm.

(c) Door
Relay contacts, dry - normally closed, open indicates alarm.

(d) Fire
Relay contacts, dry - normally closed, open indicates alarm.
- Up to six different relay inputs from up to six different areas of the building.

3.5.8.1.2 Central Computer Complex.- The input for the CCC Mode is from the interface between the CCC and SMMC at the CCCM, Section 3.12.2.

The input for GPI monitoring and control is from the GPI interface with the scanner module, Section 3.12.2.4.

3.5.8.1.3 SMMC cabinet.- These signals are internal to the SMMC.

3.5.8.1.4 Interfacility modems.- As defined in Section 3.12.3 herein.

3.5.8.1.5 Coded Time Source.- Input from the CTS will be:
Relay contacts, dry - normally open, closed indicates alarm.

3.5.8.2 Panel Configuration.- The indicators and controls for the ECM shall be mounted on a standard size "C" panel.

3.5.8.3 Functions.- The ECM shall perform and display the following monitoring functions:

3.5.8.3.1 Environmental:

(a) Air Conditioning - The ECM shall display an indication of malfunctioning of the air conditioning equipment in the ARTCC building.

(b) Radiation alarm - The ECM shall interface with radiation monitoring equipment in the ARTCC and display an alarm condition.

(c) Door alarm - The ECM shall indicate whenever the rear door to the ARTCC building is not closed.

(d) Fire alarm - The ECM shall interface with monitoring equipment in the ARTCC building to indicate a fire alarm condition.

3.5.8.3.2 Central Computer Complex.- The ECM may contain PRI's from the CCC module; such as the mode indicator.

3.5.8.3.3 GPI.- This monitoring function is associated with the monitoring and control of the General Purpose Input (GPI) adapter for the SMMC data input from the scanner module. A PRI shall indicate the following conditions for the GPI:

(a) - On line
(b) - Test/Maintenance
(c) - Report stop
(d) - Scan stop
(e) - GPI illegal
(f) - GPI demand
(g) - Error

Push button controls shall provide the following control functions:

(a) Retry - resets I/O Request line without advancing scanner.
(b) Scan start - resets scanner to start position.
(c) Send check - initiates check message
(d) Send summary - initiates summary message

3.5.8.3.4 Miscellaneous - The ECM shall:

(a) Provide CTS error indication.

(b) Provide an indication of a power failure in any of the SMMC equipment room cabinets.

(c) Indicate when any of the equipment room cabinets is in Test/ Maintenance status.

(d) Monitor SMMC power supplies.

(e) Provide a Report Inhibit control with indicator to inhibit read-in to the GPI.

(f) Provide a SMMC Reset Control to enable the read-in function to the GPI.

(g) Provide a PRI test position which will allow the quick test of PRI's at the SMMC.

3.5.9 Scanner module.- The Scanner module shall continually scan all status and performance storage points in the SMMC and transmit changes to the CCC. (Transmission of data to the CCC is under CCC control.) A complete scan shall be initiated every 250 millesec. or less.

3.5.9.1 Summary read-in.- The scanner module shall provide for initiating a summary read-in of status and performance data from the SMMC to the CCC. A switch on the SMMC shall provide for manual initiation of a summary read-in. An automatic initiation under program control shall be activated by the CCC by raising GPI Device Control Lines 1 and 4, simultaneously.

3.5.9.2 Interface requirements.- The scanner module shall interface with other modules in the SMMC to receive data for transmission to the CCC. It shall also interface with the CCC General Purpose Input adapter (GPI), as defined in Section 3.12.2 for the purpose of inputing data to the CCC.

3.5.9.3 Scanner capacity.- The total number of scan points provided by the scanner shall be sufficient to report all required data for the maximum system configuration (paragraph 3.3.1) plus 20%.

3.5.9.4 Scanner inhibit.- Switches shall be provided at the SMMC for inhibiting and enabling the read-in of data to the CCC.

Any interruption of AC power to the SMMC sufficient to disturb logical operation and cause erroneous change indications, shall cause an automatic inhibit of all SMMC messages to the CCC via the GPI. The inhibit shall remain in effect until manually revoked by the enable switch at the SMMC. A light shall indicate when data input to the CCC is inhibited.

3.5.10 Display requirements

3.5.10.1 Projection readout indicators (PRI).- Projection readout indicators (PRI's) similar and equal to IEE #120-H, shall be used on all modules except as specified herein. Each PRI shall display any one, or any combination, of the following colors and symbols:

Symbol	Meaning
Green Screen	On-Line
Amber screen	Standby
Red screen	Test/Maintenance
D	Internal Degradation
X	External Degradation
EX	External Failure
PX	Partial Failure
AL	Alert (System Engineer)
OX	Operator Failure
SS	Saturated System

3.5.10.1.2 PRI operations.- PRI logic shall be such that an indication is always present. Thus, a non-lighted PRI indicates a trouble in the PRI or its driving circuitry.

PRI logic shall be such that any automatic change; that is, any change caused by signals from the equipment being monitored, shall cause the PRI to begin to blink. The PRI shall continue to blink until an acknowledge switch is activated at the SMMC.

Each PRI shall be capable of being manually set by push button switch to any of the status or performance indications.

Push button switches for "acknowledge" and for manual operation shall be associated with each PRI.

3.5.10.1.3 Special indications.- Indicators, other than PRI's may be used for the display of the following data:

(a) Status of Nav. Aids and Communication facilities
(b) Special CD status data

    (1) DSG alarm (Duplex CD, only)
    (2) Sensitive Detector On
    (3) Sensitive Sector 1
    (4) Sensitive Sector 2
    (5) Sensitive Sector 3
    (6) Fixed Map On

(c) Radiation alarm
(d) Door alarm
(e) Air conditioning
(f) Cabinet monitoring (console and equipment room)
(g) Fire alarm
(h) CTS alarm

3.5.10.2 Cathode ray tube displays.- Cathode Ray Tube (CRT) displays in the SMMC shall meet the following requirements with the exception of the GFE CDC display.

3.5.10.2.1 Brightness.- The brightness of data on the display shall be sufficient to provide the required contrast ratio and adequate for viewing in a normally lighted ARTCC. A display brightness control shall provide a range of adjustment from zero brightness to saturation brightness. Brightness variation within a symbol, character or data line shall not exceed 5% of the average brightness for the character or data line. The brightness variation between data (individual character or symbols) shall not exceed 10% for the entire display surface.

3.5.10.2.2 Contrast ratio.- The contrast ratio of the display shall be 10 to 1 or greater, measured at any point on the display and measured with an evenly distributed, white light level of 20 foot candles ambient at the SMMC writing shelf. Contrast ratio is defined as the ratio of signal plus background brightness to background brightness alone. The measurement shall be made using a line of a width equal to the writing spot diameter. The required contrast ratio shall be met with data being displayed at the optimum brightness level to meet 3.5.10.2.1 and at the resolution specified herein.

3.5.10.2.3 Resolution.- Display resolution shall equal or exceed 50 lines per inch (equal spaced white lines) at the display center and not less than 40 lines per inch at the circumference. This measurement shall be made while meeting the brightness and contrast of the preceding paragraphs.

3.5.10.2.4 Focusing.- A focusing adjustment or control shall be provided. When adjusted for best focus, the ratio of maximum to minimum spot size measured anywhere within the useable display diameter shall not exceed 1.5 to 1. No noticeable change in focusing shall occur with changes of display brightness centering, range, etc.

3.5.10.2.5 Centering.- Electrical maintenance adjustments shall be provided for horizontal and vertical centering of the display. These controls shall provide a range of adjustment of at least one inch about the center of the useable display area and shall cause all data on the display to move an equal distance. Display centering shall not drift more than 1/8 inch from the original position over a 24-hour period.

3.5.10.2.6 Alignment.- Appropriate electrical amplitude and linearity adjustments shall be provided for alignment of the display.

3.5.10.2.7 Deflection.- The deflection linearity shall be within 0.1% of the useable display diameter, measured on the horizontal and vertical axes. Protection circuits shall protect the CRT from damage caused by loss of deflection voltage or signals.

3.5.10.2.8 Geometric distortion.- No point shall be displaced from its correct position on the display face by more than $\pm$ 0.5% of the useable display diameter.

3.5.10.2.9 Stability.- To meet performance requirements, adjustment of brightness and focus shall not be necessary more often than once every 8 hours and adjustment of centering, linearity, azimuth and other maintenance adjustments shall not be necessary more often than once every 24 hours. There shall be no noticeable jitter of the displayed data.

3.5.10.2.10 Flicker.- There shall be no perceptible flicker of the displayed data.

3.5.10.2.11 Shielding and isolation.- There shall be no flashing or distortion of sweeps and display data and no extraneous or spurious visual noise at any brightness level, such as may be caused by hum pick-up, inadequate isolation from high transient voltages and currents, or other electrical causes.

3.5.11 Power Supply.- Power supply design shall provide redundancy such that the failure of one power supply shall not cause the SMMC to fail. Power supply system design shall be such as to prevent a failure in a monitoring module from causing a failure of the power supply system. Power supplies shall be electronically regulated to maintain output voltages ± 1.0% as the load is varied from 30% less than to 20% more than the normal load, and as the line voltage is varied between the service limits. The output voltages of the power supplies shall be adjustable to any value over a minimum range of ± 10% of the nominal value and the regulation and ripple requirements shall be met at any output voltage in this range. Each regulated power supply shall employ its own reference voltage. AC ripple voltage shall not exceed 0.25 volts, peak to peak.

Unless otherwise approved by the Contracting Officer's Representative (COR), individual chassis shall be employed for each power supply unit. All power supplies shall employ solid-state rectifiers and solid-state devices throughout, to the extent practical, and shall be designed to sustain a direct short continuously without damage or overheating, and immediately return to normal upon removal of the short. Any power supply output voltage shall not change more than ± 1.0% from an initial value for the range of service conditions.

3.5.12 Ambient conditions.- The SMMC shall be designed to operate in Environment I ambient conditions as defined in FAA-G-2100/1.

3.5.13 Input power requirement.- The SMMC equipment shall operate from input power of 120 volts, 60 hertz, single phase ac with tolerances as given in FAA-G-2100/1, Section 1-3.2.23.

3.5.14 Equipment grounding requirement.- The SMMC shall be designed to provide three isolated electrical grounds, as listed below, and to provide for independent connection of these grounds to the building ground system:

1. Signal ground
2. Power neutral ground, for line filter grounding
3. Chassis safety ground

3.5.15 SMMC general construction.- The SMMC shall be designed, fabricated and constructed in accordance with all applicable requirements of FAA-G-2100/1, FAA-G-2100/2, FAA-G-2100/3 and FAA-G-2100/4.

3.5.16 Paint finish.- The following shall apply in lieu of 1-3.8.2 of FAA-G-2100/1: All exterior surfaces of the SMMC and the Equipment Room Cabinet (racks, cabinets, panels, doors, shelves) shall be finished by applying one or more uniform spray coats of baking primer, mixed, applied, and baked on in accordance with FAA-STD-012; such baking shall be followed by application of one or more uniform spray coats of a hard lusterless alkyd baking enamel having a smooth matte texture and mixed, applied, and baked on in accordance with FAA-STD-012 and TT-E-527, with exception of the units of gloss. The units of gloss of the matte finish shall be between

10 and 17 units using Federal Test Method Standard No. 141, Method No. 6103 (85-Degree Specular Gloss) as the basis for compliance. The color of the final coat shall be brown, matching Color No. 30372 of Federal Standard No. 595. The contractor shall furnish certification that metal test panels (finished along with the equipment, as specified above), have been tested for water resistance and hydrocarbon resistance, using the test procedures given in Federal Specification TT-E-527, that they have successfully met the qualitative requirements specified in TT-E-527 for these two characteristics, have been tested in accordance with Method No. 6103 of FED-STD-141 and have successfully met the gloss requirements specified herein.

3.5.17 Nameplate title.- The equipment title for nameplates, FAA-G-2100/1 1-3.13 shall be "System Maintenance Monitor Console (SMMC)." A list of equipment for which nameplate titles are to be furnished shall be submitted for approval as per 1-3.13.2.2.

3.5.18 Equipment cabinets.- Equipment cabinets shall be supplied complete with rear doors, sides, blank panels, etc., to provide physical enclosure of the cabinets. Cabinets shall meet the requirements of FAA-E-163b.

3.6 Communications requirements

3.6.1 Telephone/interphone requirements.- The contractor shall design and fabricate the SMMC to provide for the installation of GFE telephone/ interphone equipment and cables for two operating positions. The contractor shall provide the following for each position:

1. A standard size panel with cut outs and mounting provisions for mounting six key packs, type 395-A.

2. Cut outs and mounting provisions in the writing shelf for two Western Electric Company, push button dials - type 24-A dial with P-38C 602 panel assembly.

3. Mounting provisions for four single headset jacks, type 80, under the forward edge of the writing shelf.

4. Mounting provisions for two speakers.

5. Separate cable ducts or conduit for all telephone company cables in the SMMC.

6. Dust tight, back enclosures for the panel mounted key packs and the push button dials.

7. Space for mounting terminal block(s) in the SMMC.

8. Cable entrance(s) for telco cables.

The Government will supply detailed engineering drawings or sample units to the contractor for the design of installation and mounting details for the telephone equipment.

3.7 Cables.- The contractor shall furnish all cables, cable connectors, terminal boards, etc., required for factory test and for installation and testing of the equipment at final destination, including any special purpose test cables required for routine maintenance. The contractor shall provide adequate patch cables and plug connectors for normal operation and maintenance of the equipment. Cables supplied for factory testing may be subsequently used for equipment installation and test, if approved by the FAA inspector.

3.7.1 Fabrication of cables.- All cables, used in or supplied with the equipment, shall conform with the requirements of FAA-G-2100/1 and shall be supplied complete with fittings and connectors. External cabling shall be unshielded, except where necessary to meet interference requirements.

3.7.2 Intraconnection cables.- The equipment shall be supplied complete with all intraconnection cables, fittings, and connectors. The approximate length of cable run between the console and the equipment room racks will be provided by the FAA for each location at least 6 months prior to delivery of equipment. The maximum cable run for any site will not exceed 300 feet.

3.7.3 Interconnection cables.- The contractor shall supply all interconnecting cables between the SMMC equipment and the NAS equipment elements being connected. Interconnection cables shall be supplied complete with connectors which are compatible with connectors in the equipment being interfaced. The approximate length of cable required between the SMMC equipment and the various NAS equipment will be provided by the FAA at least 180 days prior to delivery of equipment at each site. The maximum cable run for any interconnection cable for any site will not exceed 300 feet.

3.8 Reliability and maintainability

3.8.1 Reliability requirements.- The design shall provide for a definite indication whenever any portion of the monitoring function in the SMMC is inoperative.

3.8.1.1 MUT/MDT requirement.- The SMMC shall be designed for continuous, reliable operation, ease of maintenance, quick location of trouble and fast repair or replacement of a failed unit. The SMMC shall have a Mean Up Time (MUT) of 5×10^3 hours per module, as a minimum. The SMMC MDT (Mean Down Time) shall not exceed 1 hour per module. The contractor shall provide computations of MUT/MDT for each module as part of the Design Data. In computation and testing of MUT for a module, power supplies furnishing power to the module shall be considered as part of the module.

3.8.1.2 Reliability program plan.- The required reliability shall be obtained through a reliability program performed in accordance with MIL-STD-785 and the following:

a. MIL-HDBK-217 and revisions to date of award shall be utilized as required by MIL-STD-785.

b. The contractor shall perform an analysis of the proposed design for the equipment to determine compatibility with the required MUT. A failure rate shall be assigned to each part in the equipment in accordance with the data presented in the latest revision to MIL-HDBK-217. Parts not included in the coverage of MIL-HDBK-217 shall be assumed to possess the failure rate of the most similar part in MIL-HDBK-217. Where this is not feasible, the best existing data shall be used.

3.8.2 Maintainability requirements.- The SMMC equipment shall be carefully engineered for quick, easy repair and maintenance. Maintenance adjustments in the form of easily accessible potentiometers shall be provided for adjustment of equipment operating parameters for obtaining optimum performance. All electronic circuitry except for power supplies shall be on easily replaceable, plug-in printed circuit cards. Layout of PC cards shall be functional to allow a quick determination of unsatisfactory operation from input/output testing and the quick restoration of equipment operation by replacement of a card.

3.8.2.1 Test points.- Test points shall be provided for measurement and observation of such voltages and waveforms as are needed for the adequate checking of performance and for the maintenance of individual units. Except where the functioning of the circuits would be adversely affected by long leads, test points shall be conveniently accessible on front panels or immediately behind the access doors of all units. Test points necessary for alignment and adjustment purposes shall be provided at the front of plug-in cards and shall be accessible without a card extender. Test points for waveforms shall be provided with jacks for use with oscilloscope test leads.

Tip-jacks shall be provided for the measurement of voltages, with red tip-jacks for positive potentials, white tip-jacks for negative potentials, and black tip-jacks for ground. Tip-jacks used for observation of waveforms shall be green. All test points shall be identified with a TP number; and the voltage value, signal waveform, descriptive title (if voltage value or waveform would not be particularly significant) shall be indicated adjacent thereto, as well as on each schematic diagram. Only descriptive titles for voltage values shall be shown for test points on exterior front panels. Suitable plastic cards may be used to illustrate interior waveforms where the specified methods of interior marking are impractical. The SMMC equipment shall be designed to provide for connections to such test equipment as may be required for its installation, maintenance, calibration, and repair.

3.8.2.2 Maintenance controls.- Maintenance controls for units using vertical panel construction shall be on the front surface of the panelof the unit with which the control is associated. All controls for horizontal chassis units shall be mounted on front panels or immediately behind front access panel doors of each unit (if equipped with access doors). All controls shall be mounted so as to prevent the possibility of personnel coming in contact with high voltages and components operating at high temperatures. Controlled functions (such as gain and voltage) shall increase with clockwise rotation as viewed from the front of the control. There shall be no noticeable lag between the actuation or adjustment. All controls shall have calibration markings to permit setting to predetermined positions, except where it can be demonstrated to the satisfaction of the Government that such compliance is impractical or unnecessary. Normal settings of a control shall not fall in the first 10% or last 10% of angular travel.

Maintenance controls shall employ small knurled knobs or screwdriver adjustment, as appropriate.

3.8.2.3 Maintenance adjustments.- The contractor shall provide the maintenance adjustments and controls necessary to maintain the SMMC equipment. Prior to start of production, the contractor shall submit data showing the maintenance adjustments and controls being provided and the purpose of each.

3.8.2.4 Extender cards.- The contractor shall provide extender cards for each type of PC board in the equipment, in the quantities required by the contract.

3.8.2.5 X-Ray radiation.- Protection from X-ray radiation shall be provided in accordance with FAA-G-2100/1, 1-3.5.4.

3.8.2.6 Maintainability program.- The required maintainability shall be achieved through a maintainability program performed in accordance with MIL-STD-470 and MIL-STD-471. The terms and definitions for maintainability not otherwise described or delineated herein shall be in accordance with MIL-STD-721. All electronic and mechanical equipment and components shall be designed and constructed to minimize skill, experience and time necessary to disassemble, assemble, and maintain them. Corrective maintenance shall use a remove-and replace philosophy with actual repair of the replaced module to be accomplished later in a separate maintenance area.

3.9 Noise level limits.- The noise level limits as specified in FAA-G-2100/1, 1-3.5.11 apply as follows:

a. System Maintenance Monitor Console - Condition B
b. Equipment Room Equipment - Condition B

3.10 Documentation.- The following documentation shall be supplied in the quantities and at the times specified by the contract.

3.10.1 Design data.- As required by the contract, the contractor shall submit detailed design data for FAA review. The design data shall be submitted in loose leaf or similar, binders for easy revision. The contractor shall update the design data every 90 days by submitting revision pages and shall submit a final revised design data document 30 days prior to completion of the contract. The design data shall contain the following listed data, as a minimum.

3.10.1.1 Functional description.- The design data shall contain a detailed functional description of the equipment which shall include such information as electrical characteristics, theory of operation, relationships to other equipments, and related data.

3.10.1.2 Block diagram.- The design data shall contain a complete set of equipment block diagrams which show functional relationships, data flow and related information.

3.10.1.3 Input/Output data.- The design data shall contain consolidated data of the input/output characteristics of the SMMC equipment. This data shall contain such information as cable characteristics, signal requirements, levels, impedances, limits, power requirements, and other related data.

3.10.1.4 Physical description.- The design data shall include a physical description of the SMMC equipment including line drawings. The description shall include weight and dimensions, equipment layout in racks and console, ventilation arrangements, cable entries and exits, overall configuration and other information necessary for installation planning.

3.10.1.4.1 Ductwork and power data.- The contractor shall provide engineering data describing the ductwork, junction boxes, cable types (power and signal) and cable connectors required to install and interconnect the SMMC equipment.

3.10.2 Test specifications.- The contractor shall provide test specifications and data sheets, as required by FAA-G-2100/1, section 1-4.2.

3.10.3 Test equipment list.- The contractor shall submit a complete list of test equipment and accessories, including recommended types, models and manufacturers; required for routine maintenance, alignment and testing of the equipment. A list of any special test equipment, special working equipment, tools, devices and accessories required to test, repair and maintain the SMMC shall also be submitted with a detailed technical discussion describing the special test equipment, its function and use.

3.10.4 Instruction books.- The contractor shall provide instruction books in accordance with the requirements of FAA-D-638, of the types and quantities required by the contract.

3.10.5 Technical reports.- Type I progress reports shall be submitted by the contractor in accordance with FAA-D-2129.

3.10.5.1 PERT progress reporting.- Thirty days after contract award, the contractor shall furnish FAA a proposed work breakdown structure and a supporting PERT Time network. Both of these items will show all activities from contract award to delivery of the first production unit as well as the start of factory tests and delivery of subsequent production units. All deliverable items such as the prototype unit, design data, spare parts lists, etc., and all activities requiring FAA action shall be included on the work breakdown structure and PERT network.

Upon approval by FAA, the PERT network will become the master schedule on which the contractor's monthly reports will be made to FAA. Event numbers for this net will be provided by FAA. Reports will be as of the tenth of the month and shall be delivered to FAA no later than the twentieth. Three copies shall be furnished. They shall each comprise three parts:

1. An updated PERT network showing actual dates for completed events, annotations to show any time or logic changes to the preceding month's network, and the critical path.

2. A tabular report in PERT format showing, as a minimum, expected completion dates and slack.

3. A narrative analysis covering:

    a. The general outlook.

    b. A summary of accomplishments during the month on activities underway.

    c. Rationale behind any time or logic changes.

    d. Present and potential problem areas along with any proposed corrective actions.

Where applicable, the above provisions supercede FAA-D-2129 as amended. Section 5.4.f, Art Size, of FAA Standard 007 is waived.

3.10.6 Engineering drawings.- All engineering drawings submitted by the contractor shall meet the requirements of FAA-STD-002.

3.10.7 Microfilm copies.- Within ninety days after final acceptance by the Government of the first complete SMMC equipment group, the contractor shall furnish two complete microfilm copies of all engineering drawings prepared under the contract. Microfilm copies of all engineering drawings prepared by subcontractors or by manufacturers of components used in the SMMC shall be included.

The microfilm shall be 35 mm size, mounted on a standard size punch card. The card shall be similar and equal to Minnesota Mining and Manufacturing Company, Type MMM 1625. Each card shall be labeled with the FAA contract Number, the Manufacturer's name and drawing number and the drawing title. If a drawing is revised after being microfilmed and prior to the end of the contract, a replacement card and microfilm shall be furnished.

3.11 Cooperation and coordination.- The contractor shall cooperate and coordinate with other contractors working on the National Airspace System or the National Airspace System Program as requested by the Contracting Officer. Such cooperation and coordination will consist of participating in FAA sponsored meeting with other contractors, providing technical data on SMMC performance and design to other contractors, and reviewing other contractor's data as it pertains to the SMMC.

3.12 Detail interface requirements.- The following paragraphs describe the electrical interfaces between the SMMC and the equipments with which it connects, to perform the system monitoring function.

At the contractor's request, the FAA will provide additional interface details or arrange for discussion(s) with the equipment contractor to determine technical details of the interface and interface signals.

3.12.1 DRG interface.- This interface provides data messages, status messages and test messages from the remote facility and alarm signals from the DRG. The data and test messages shall be processed for display on the SMMC RAPPI display, when selected. The status messages will be identified by the DRG by setting a bit on the "status message" line. The SMMC shall decode each status message and display the status and performance information contained therein.

3.12.1.1 Connector.- The connector at the DRG will be:

AMP-18 position connector block #201155-2 with adapters for RG-62B/U cable.

3.12.1.2 Data, status and test messages.- Each DRG provides messages to the SMMC over three parallel data channels. The signals and signal characteristics are listed below:

Signal	Nominal Voltage	Pulse Width	Termination
Channel 1 -			
SOM	0 or + 5v.	417 micro sec.	100 ohms to ground
Data	0 or + 5v.	417 micro sec.	100 ohms to ground
Clock	0 or + 5v.	2.7 micro sec.	100 ohms to ground
Parity	0 or + 5v.	417 micro sec.	100 ohms to ground
EOM	0 or + 5v.	417 micro sec.	100 ohms to ground
Status	0 or + 5v.	417 micro sec.	100 ohms to ground

Channel 2-

Same as channel 1 above.

Channel 3-

Same as channel 1 above.

3.12.1.2.1 Signal characteristics.- Messages are received on the data line at a 2400 bits per second rate. Message formats and detailed characteristics of the DRG signals may be found in Specification FAA-E-2235.

3.12.1.2.2 Status message.- This message consists of four fields, thirteen bits per field = twelve bits plus parity. The following table lists the monitoring data contained in the status message, related to bit number.

Bit #	Designation	Sense
14	Radar Alarm	1 = failure of on-line radar
15	Beacon Alarm	1 = failure of on-line beacon
16	CD Alarm	1 = failure of on-line CD
20	Standby Radar Alarm	1 = failure of standby radar
21	Standby Beacon Alarm	1 = failure of standby beacon
22	Standby CD Alarm	1 = failure of standby CD
29	DSG Alarm	1 = failure to transfer
34	Sensitive Detector On	1 = On
35	Run Length Disc. On	1 = On
40	Outer Contour - Weather	1 = On
41	Inner Contour - Weather	1 = On
42	Fixed Map On	1 = On
43	Output Timing Alarm	1 = Failure of Modem Clock
44	1/2 Scan Inhibit	1 = Deletion of target held in storage for more than 1/2 scan
45	Buffer Overload Alarm	1 = Buffer load 50%
49	Sensitive Sector #3	1 = Sensitive Sector On
50	Sensitive Sector #2	1 = Sensitive Sector On
51	Sensitive Sector #1	1 = Sensitive Sector On

3.12.1.3 Alarm indication.- Each DRG provides alarm signals for each channel as follows:

Signal	Voltage	Sense	Termination
Channel 1 - Alarms			
Channel Disable	0 or +5v.	0 = Alarm	100 ohms to ground
Timing Error	0 or +5v	0 = Alarm	100 ohms to ground
Synchronization	0 or +5v	0 = Alarm	100 ohms to ground

Channel 2 - Alarms
Same as Channel 1 above.

Channel 3 - Alarms
Same as Channel 1 above.

3.12.1.3.1 Signal levels.-
Normal condition = +5.0 volts $\pm$ 2.0 volts
Alarm condition = 0 volts $\pm$ 0.5 volts

3.12.2 CCC interface.- This interface utilizes four connectors for signals from the System Console (SC) to the SMMC and one connector at the General Purpose Input Adapter (GPI) for signals and data to and from the SMMC.

3.12.2.1 Connector type.- The cable connectors for the SC and the GPI are: SC-IBM 48 pin, type B, Serpent connector #5362313 with proper insert for cable. GPI-IBM 24 pin, Type A, Serpent connector #5393087 with proper insert for cable.

3.12.2.2 Cables.- Multiconductor shielded cables with matching Serpent type connectors at the CCC end are required for connecting to this interface.

3.12.2.3 System console/SMMC.- The SC/SMMC interface provides the following signals:

Configuration	- 100 lines
Mode	- 10 lines
Power Check	- 25 lines

3.12.2.3.1 Configuration signals.- The configuration signals represent four (4) rows of lamps (25 per row) on the System Console, which display the configuration of the CCC equipment. Each row of lamp signals represents equipment elements as follows:

CE	IOCE	SE	PAM	TCU
1 2 3 4	1 2 3	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3	1 2 3

The configuration signals are activated under CCC program control and will show each equipment element to be in one of the following configurations:

(a) On-line, ATC processing (first row of lamps)
(b) Standby, Available for ATC processing (second row of lamps)
(c) Test/Maintenance, Unavailable (third row of lamps)
(d) Presently not used (fourth row of lamps)

3.12.2.3.2 Mode signals.- The 10 mode indicator signals represent three alpha and seven numeral indications. These correspond to the digital readout device on the System Console which displays one alpha and one numeral. The following mode signals are provided, any one alpha and any one numeral will be displayed at a given time.

Alpha	Numerals
A	1
B	2
C	3
	4
	5
	6
	7

3.12.2.3.3 Power check signals.- The 25 power check signals represent four CE's, three IOCE's, twelve SE's, three PAM's and three TCU's. The signal will be activated by its respecitve element when any one of the following conditions exist:

Normal Power off
Over temperature condition
Failure of power supply

3.12.2.3.4 Signal parameters

Configuration -

Significant level positive (lamp on)
Max. up level - +5.75 V.
Min. up level - +4.50 V.

Non-Significant level (lamp off)
Max. down level - +3.0 V.
Min. down level - 0.0 V.

During a period of preventative maintenance on the System Console, the significant level may be as high as +6.75 V. and as low as +3.0 V. The down levels will remain the same.

Mode - same levels as configuration above

Power check -

*Significant signal (Power check indicated)is +27.0 $\pm$ 3 V. DC.
Absence of voltage (ground or open) indicates no power check.
*Signal is unfiltered output of full wave, 60 Hz rectifier.

3.12.2.3.5 Termination impedance.- The CCC signals require the following resistance load at the SMMC:

Configuration signals	-510 ohms
Power check signals	-750 ohms
GPI lines (data & control)	-100 ohms
Mode indicator	-510 ohms

3.12.2.4 GPI/SMMC.- The GPI adapter receives control and data signals from the SMMC and sends control signals to the SMMC. Technical details of this standard interface are contained in the Central Computer Complex (CCC) Design Data dated September 20, 1965, with Errata/Revision dated January 14, 1966. This data will be provided to the contractor by the Government. The contractor shall design the SMMC message generation and logic circuits in such a way that no change is required in the CCC operational program to process messages from the SMMC other than to change adaptation tables.

The contractor shall provideadaptation tables of the types illustrated by Figures 3a, 3b and 3d for each site, at the time of equipment delivery.

3.12.2.5 SMMC/GPI message formats.- The SMMC shall generate and transmit to the GPI the following types of messages: (1) change message (2) summary message (3) summary read-in message and (4) check message.

The change message shall consist of four bytes (one equipment element) which will identify the equipment and contain status/performance information. Each byte shall consist of eight bits plus an odd parity bit. An EOM signal shall follow each change message.

The summary messages will provide information on the status and performance of all the equipment monitored in the system. Each summary message, except the last, shall contain 512 bytes which shall provide status/performance data for 128 equipment elements. An EOM shall terminate each summary message. The last summary message may have less than 512 bytes depending upon the number of equipment elements and shall contain an End of Summary (EOS) bit in the first byte of the last equipment reported.

Data transfer for all messages shall be byte serial, bit parallel, (See Figure 2).

3.12.2.5.1 Information Content; first byte.- The first byte shall distinguish between a change and a summary message, indicate if an end of summary (EOS) is present and, along with the second byte, provide equipment identity (See Figure 2).

Bit Position	Meaning
0	Distinguishes between change and summary message 0 = Change message 1 = Summary message
1	Indicates if EOS present 0 = No EOS 1 = EOS

Bit Position	Meaning
2 thru 4	Unassigned
5 thru 7	Combines with second byte to identify equipment

3.1.12.2.5.2 Information content, second byte.- All bits of the second byte combined with the last three bits of the first byte shall be coded in binary code to identify the equipment being reported. The most significant bit of the equipment code shall be bit 5 in the first byte and the least significant bit, bit 15 in the second byte (See Figure 2). The equipment code number will cause the CCC program to select the assigned printout table and mnemonics to be printed.

3.12.2.5.3 Information content bytes three and four.- These bytes contain the status/performance data for the change and summary messages. All bits in byte 3 and the first four bits of byte 4 are used for data coding. The attached table (Figure 3) illustrates the method of coding the status/performance data.

3.12.2.5.4 Message processing.- Change messages shall be initiated immediately by the SMMC whenever a change of status/performance occurs at the SMMC.

Summary messages (a summary report) shall be initiated in two ways, (1) by manual activation of a switch at the SMMC and (2) by program action from the CCC. The CCC will raise GPI Device Control Lines 1 and 4 simultaneously to request a Summary Report from the SMMC.

A summary report will be preceded by a 4-byte element (SRI) which will cause the I/O typewriter to printout that a summary is in process. An EOM shall be sent after each 512 bytes of the Summary report. An interrupt will occur after each EOM until a new read command is initiated by the CCC program. This cycle will continue until an End of Summary (EOS) is received.

A check message will be generated by the SMMC which will have a unique identity code and bit 3 set in the fourth byte, and which will be processed as a normal change message.

The Summary Read-In message (SRI) will have the same identity code as the check message but with a different bit set in byte 4.

3.12.3 Modem interface.- Each of the simplex receiving modems for the data channels from the radar facilities and each of the duplex transmit/receive modems for interfacility data transfer will provide alarm indications for loss of power and loss of signals.

3.12.3.1 Connector.- To be determined by the contractor.

3.12.3.2 Signal.- The signal from each modem is furnished by a set of dry closure relay contacts with the closed contacts indicating Normal.

3.12.3.3 Signal level.- Not applicable.

3.12.4. CDC interface.- The CDC has two separate and distinct interfaces with the SMMC. One interface is at the Reconfiguration Unit (RU) and is a digital message type interface. The other is at the Non-Radar Keyboard Multiplexers and is a hardware (signal per wire) type interface.

3.12.4.1 Connector.- To be determined by the contractor.

3.12.4.2 Signal description.- To be defined in CDC Design Data Revision - Raytheon Company.

3.12.4.3 Signal levels.- Same as 3.12.4.2 above.

3.12.4.4 Terminations.- Same as 3.12.4.2 above.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- The quality assurance provisions specified in FAA-G-2100/1 Section 1-4 shall apply. The contractor shall perform the four classes of tests listed in Section 1-4.3. The contractor's inspection shall be in accordance with MIL-I-45208A.

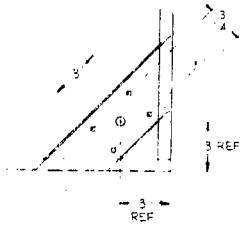
5. PREPARATION FOR DELIVERY.- Preparation for delivery shall be in accordance with Military Specification MIL-E-17555, "Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of."

6. NOTES

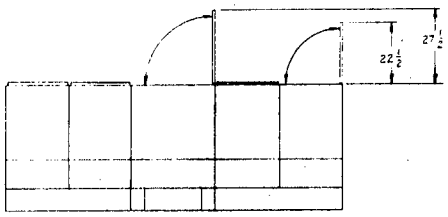
6.1 Figure 1.- The attached outline drawing of the SMMC Figure 1, illustrates general form factor only and is intended as an aid for understanding the physical description of the console contained in this specification. The drawing is not intended to specify exact dimensions or construction details.

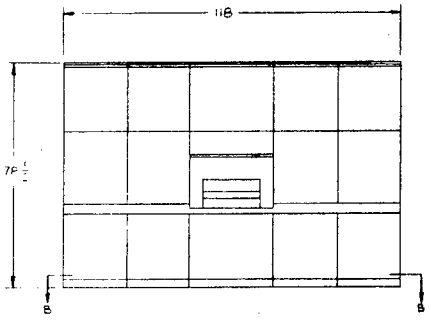
* * * * *

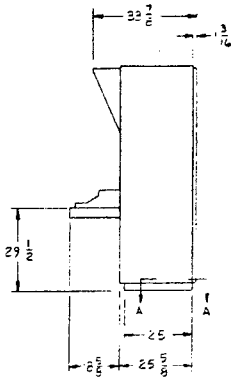
FOR FIGURES 1, 2, 3, SEE PAGES 34 TO 39



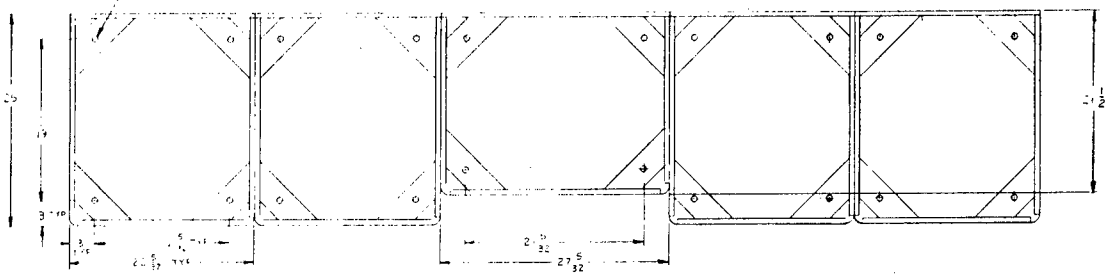
SECTION A-A
TYPICAL ALL CORNERS, ALL CABINETS







.496 DIA
4 HOLES PER CABINET



SECTION B-B

FIGURE 1

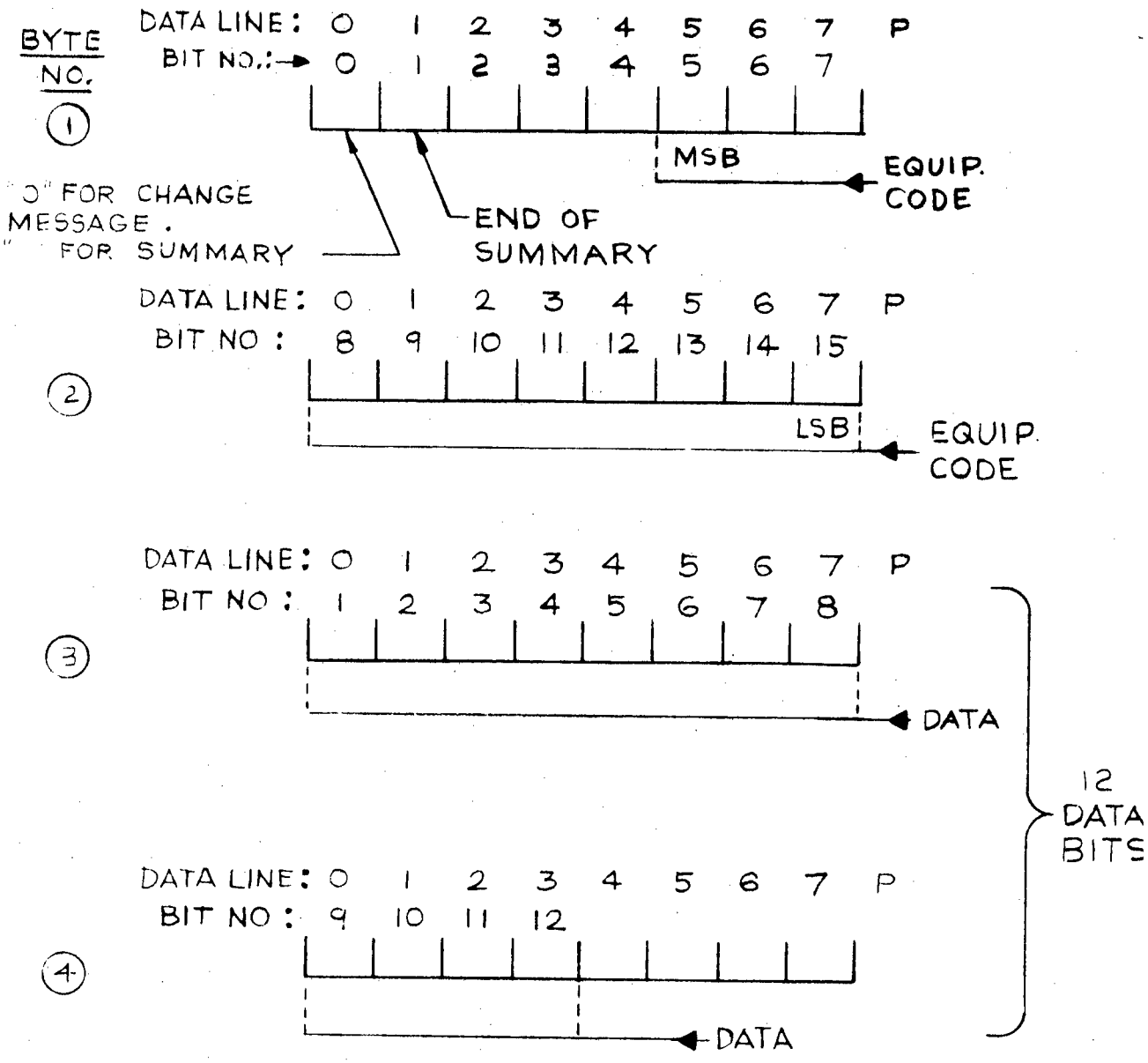

BYTE NO.
DATA LINE: 0 1 2 3 4 5 6 7 P
BIT NO.: 0 1 2 3 4 5 6 7
1
MSB
EQUIP. CODE
"0" FOR CHANGE MESSAGE.
" FOR SUMMARY
END OF SUMMARY
DATA LINE: 0 1 2 3 4 5 6 7 P
BIT NO: 8 9 10 11 12 13 14 15
2
LSB
EQUIP. CODE
DATA LINE: 0 1 2 3 4 5 6 7 P
BIT NO: 1 2 3 4 5 6 7 8
3
DATA
12 DATA BITS
DATA LINE: 0 1 2 3 4 5 6 7 P
BIT NO: 9 10 11 12
4
DATA

FIGURE 2

EXAMPLE OF DISPLAY UNIT POSITION ASSIGNMENT - NAFEC

BAY 0 - Module 0

*Display Position	Display Assignment	Ident. to be Printed	Data Print-out Table
0	Radar	ELW RDR-OLN	1
1	Radar	ELW RDR-SBY	1
2	Beacon	ELW BCN-OLN	1
3	Beacon	ELW BCN-SBY	1
4	Digitizer	ELW RVDP	1
6	Digitizer	ELW RVDP	2
8	Modem	MOD-1	1
9	Data Rec.Grp.	ELW DRG CH 1	1
10	" "	ELW DRG CH 2	1
11	" "	ELW DRG CH 3	1
12	Radar	PHL RDR-OLN	1
13	Radar	PHL RDR-SBY	1
14	Beacon	PHL BCN-OLN	1
15	Beacon	PHL BCN-SBY	1
16	Digitizer	PHL RVDP	1
18	Digitizer	PHL RVDP	2
20	Modem	MOD-2	1
21	Data Rec. Grp.	PHL DRG CH 1	1
22	Data Rec. Grp.	PHL DRG CH 2	1
23	Data Rec. Grp.	PHL DRG CH 3	1

*Presented to GPI in Binary Code

BAY 0 - Module 1

Equip. ID	Equip. Type	Ident. to be Printed	Data Print-out Table
24	Radar	SUT RDR-OLN	1
25	Radar	SUT RDR-SBY	1
26	Beacon	SUT BCN-OLN	1
27	Beacon	SUT BCN-SBY	1
28	Digitizer	SUT RVDP	1
29			
30	Digitizer	SUT RVDP	2
31			
32	Modem	MOD-3	1
33	Data Rec.Grp.	SUT DRG CH1	1
34	" "	SUT DRG CH2	1
35	" "	SUT DRG CH3	1
36	Radar	ACY RDR-OLN	1
37	Radar	ACY RDR-SBY	1
38	Beacon	ACY BCN-OLN	1
39	Beacon	ACY BCN-SBY	1
40	Digitizer	ACY RVDP	1
41			
42	Digitizer	ACY RVDP	2
43			
44	Data Transmitter Grp.	ACY DTG	1
45			
46			
47			

FIGURE 3a

EXAMPLE OF DISPLAY UNIT POSITION ASSIGNMENT - NAFEC (continued)

BAY 0 - Module 2

*Display Position	Display Assignment	Ident to be Printed	Data Print-out Table
48	Data Filter Grp.	DFG-1	11
49	Per Channel Status	** Channel	5
50	Data Filter Grp.	DFG-2	11
51	Per Channel Status	** Channel	5
52	Data Filter Grp.	DFG-3	11
53	Per Channel Status	** Channel	5
54	Data Filter Grp.	DFG-4	11
55	Per Channel Status	** Channel	5
56			
57			
58			
59			
60	A/N Generator	ANG-1	1
61	A/N Generator	ANG-2	1
62			
63			
64	Computer Entry Readout Control	CERC-1	1
65			
66			
67			
68	RBDE-5 Control Rack Assy.	CRA-A	1
69			
70			
71			

BAY 0 - Module 3

Equip. ID	Equip. Type	Ident. to be Printed	Data Print-out Table
72	Scan Converter	SC-1	1
73	Scan Converter	SC-2	1
74	Scan Converter	SC-3	1
75	Scan Converter	SC-4	1
76	Scan Converter	SC-5	1
77	Scan Converter	SC-6	1
78	Scan Converter	SC-7	1
79	Scan Converter	SC-8	1
80	Scan Converter	SC-9	1
81	Scan Converter	SC-10	1
82	Scan Converter	SC-11	1
83	Scan Converter	SC-12	1
84	Scan Converter	SC-13	1
85	Scan Converter	SC-14	1
86	Scan Converter	SC-15	1
87	Scan Converter	SC-16	1
88			
89			
90			
91			
92			
93			
94			
95			

* Presented to GPI in Binary Code

** Any combination of failed DFG channel numbers may appear behind CH. As an example: CH1, CH4, CH10.

EXAMPLE OF DISPLAY UNIT POSITION ASSIGNMENT - NAFEC (continued)

BAY 0 - Module 4

+ Display Position	Display Assignment	Ident. to be Printed	Data Print-out Table
96	*	R Console-1	11
97	**	R Console-1	2
98	*	R Console-2	11
99	**	R Console-2	2
100	*	R Console-3	11
101	**	R Console-3	2
102	*	R Console-4	11
103	**	R Console-4	2
104	*	R Console-5	11
105	**	R Console-5	2
106	*	R Console-6	11
107	**	R Console-6	6
108	*	R Console-7	11
109	**	R Console-7	6
110	*	R Console-8	11
111	**	R Console-8	6
112	*	R Console-9	11
113	**	R Console-9	6
114	*	R Console-10	11
115	**	R Console-10	2
116	*	R Console-11	11
117	**	R Console-11	12
118	*	R Console-12	11
119	**	R Console-12	12

Bay 0 - Module 5

Equip. ID	Equip. Type	Ident. to be Printed	Data Print-out Table
120	CCC-Peripheral Adapter Module	PAM-1	1
121	" "	PAM-2	1
122	" "	PAM-3	1
123			
124	CCC-I/O Control Element	IOCE-1	1
125	" "	IOCE-2	1
126	" "	IOCE-3	1
127			
128	CCC-Compute Element	CCE-1	1
129	" "	CCE-2	1
130	" "	CCE-3	1
131			
132	CCC - Storage Ele.	CSE-1	1
133	" " "	CSE-2	1
134	" " "	CSE-3	1
135	" " "	CSE-4	1
136	" " "	CSE-5	1
137	" " "	CSE-6	1
138	" " "	CSE-7	1
139	" " "	CSE-8	1
140	" " "	CSE-9	1
141	" " "	CSE-10	1
142			
143			

* 96 Radar Console to System Engineer Failure Message

** 97 System Engineer to Radar Console Status Message

\+ Presented to GPI in Binary Code.

FIGURE 3-

BAY 0 - Module 6

*Display Position	Display Assignment	Ident. to be Printed	Date Print-out Table
144	Building Alarms	Bldg. Alarms	3
145			
146	Power Source	Pwr. Source	3
147			
148	Equip.Floor Cabinets	EFC	6
149			
150			
151			
152			
153			
154			
155			
156			
157			
158			
159			
160			
161			
162	CCC Mode	CCC Mode	4
**163	Summary Read-In or	SMMC	4
	Check Report	SMMC	4
164	CCC-Tape Control Unit	TCU-1	1
165	" " "	TCU-2	1
166	" " "	TCU-3	1
167			

Equip. ID.	Equip. Type	Ident. to*** be Printed	Data Print-out Table
192	Comm/Navaids	ABY	7
193			
194	Comm/Navaids	AGS	7
195			
196	Comm/Navaids	ALD	7
197			
198	Comm/Navaids	AMG	7
199			
200	Comm/Navaids	AYS	9
201			
202	Comm/Navaids	CAE	9
203			
204	Comm/Navaids	CEW	9
205			
206	Comm/Navaids	CHS	8
207			
208	Comm/Navaids	CRE	8
209			
210	Comm/Navaids	CTF	8
211			
212	Comm/Navaids	CTY	7
213			
214	Comm/Navaids	DAB	8
215			

* Presented to GPI in Binary code.

** SummaryRead-In is also identified in BIT position 0, BYTE 1 of the SMMC message.

*** Comm/Navaid identities are JAX - associated.

FIGURE 3d